

the rocks, in order to get down below the hot, dry rocks to where there was a little moisture.

It seems apparent that the living shells live among the loose stones, in the early spring crawling around over the damp rocks. As the warm spring and summer days approach, the rocks become dry. The snails previously crawling over them cease activity, and instead of all of them crawling for protection under the loose rock, some throw their protective film across the opening of the shell while yet on the rocks; the sun kills the animal, which dies, leaving the dead shell to bleach and become a conspicuous feature on the rocks. Here the shells remain, very few of them washing any distance.

All of the living shells taken appeared dead except a few. Invariably, however, when a shell sank in water the snail within was alive. It is probable that the species is continued by the hibernation of some of the more fortunate individuals which are deeper in the rocks, where there is more moisture.

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#### ADAPTATION OF MOLLUSKS TO CHANGED CONDITIONS.

BY A. C. BILLUPS, LAWRENCEBURG, INDIANA.

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Many years ago the Ohio river at and below Cincinnati, Ohio, was one of the most prolific hunting grounds of the collector of the fresh-water species of mollusks. At that time abounded in immense numbers (as is shown by the large quantities of duplicates in the collections of all the old collectors) *Anculosa praerosa* Say. About twelve years ago this shell disappeared almost entirely and for many years not a single specimen was found; this year, however, a few adults and large numbers of young shells have been found in localities where it is certain that no shells have existed for many years. The explanation of this occurrence is as follows; *A. praerosa* Say was a long time ago one of the most common of the river snails; the growth of the city of Cincinnati and the numerous factories along the banks of the river, each and every one adding to the filth of the water, pouring in sewage and acids, have rendered the water so foul that the *Anculosa* of the old day have been exterminated, all but a few of the most hardy of the species, which probably crawled to the lowest and most inaccessible parts of the river, where they managed to exist and to produce young: the young shells have become more used to the changed conditions, which worked such havoc with their ancestors,

and their descendants are so little affected by the foul water that they are now thoroughly acclimated and are producing young in large numbers used to the surrounding conditions. As this is the case, we may now look for *Anculosa praerosa* Say in nearly all its old haunts, where it will thrive under conditions which would have proved fatal to its ancestors. Many of our forest snails have been forced, by the clearing of the timber and tilling of the soil, to more or less adapt themselves to conditions not slightly, but very materially changed from those to which they were originally used. One of the most ready to take to the new mode of life was perhaps *Pyramidula alternata* Say, which is now one of the most sociable snails that exists in North America; this snail can be found in all our cities and doing well surrounded by conditions which are, without the slightest doubt, entirely strange to its nature—the rubbish heaps in every back yard harboring hundreds of fine and well-developed specimens in every stage of growth. Another forest snail which has taken kindly to open country life is *Polygyra appressa* Say. By setting a trap (a board greased with lard, placed about one inch above the ground) in a dark and damp alley between two houses in a low part of the town, I captured in ten nights the following number of snails: 9, 12, 10, 13, 26, 23, 18, 21, 12, 11—in all 155 adult specimens; young and immature specimens were not counted. This trap cleaned up all the snails in the immediate vicinity, as after that date the captures began to drop off and at the end of three weeks no more were taken. *P. monodon* Raek. and *inflecta* Say have in a smaller degree taken to open country life and are now common on nearly every railroad cut or fill under old cross-ties, but in nearly every instance deprived of the shade of the trees which seemed to be so necessary to their original abode. With *Pol. albolabris* Say and *exoleta* Binn., however, the change from woodland to open country does not agree. I have for years tried the experiment of transporting these eminently forest snails to places which, while being favorable for their maintenance, were still very different from their native haunts, and the result has been with both species a signal failure, and of three thousand that I transported three years ago, a very few only have managed to survive. They laid many eggs but very few of them ever hatched, and at the present time I doubt if there are twenty living snails to be found. *Pol. thyroides* Say is perhaps of the larger snails the most hardy, and the least affected by changed conditions. Mr Geo. H.

Clapp, of Pittsburg, Pa., informs me that *Vallonia* has adapted itself to open life and can now be collected in immense numbers in places very different from its original haunts. The question of the adaptation of mollusks to changed conditions is one of great interest, and in no country can the subject be so well studied as in America, where man and man's inventions change the whole face of an immense tract of country in a very short time. We know that the object of molluscan life (and in fact all life) is to preserve its own existence and to reproduce its own species. With rapidly-changing conditions, the snail must either adapt itself to these conditions or cease to exist, and it will be most interesting for many years to come to watch the struggle and to record the cases of success or failure. Complete local lists of species carefully made up, collections of large series of species from every possible locality and a knowledge of that locality and its conditions, will enable all students in this branch of molluscan evolution to arrive at a convincing and satisfactory conclusion. While in the older countries of Europe the forest snail has become now adapted to open country life, we have no records to bear upon the time when this change was taking place, and in all probability it was much more gradual than will be the case in this country of rapid and great changes.

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#### NEW LAND SHELLS OF THE JAPANESE EMPIRE.

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BY H. A. PILSBRY AND Y. HIRASE.

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As already stated in a former number of the NAUTILUS, Mr. Nakada spent the autumn in exploration in the Hokuriku region, which includes provinces along the west coast of middle Hondo. The material examined shows that area to have but few endemic species, most of those collected being widely-distributed forms, already well known from other places. He reached Sado Island, where he found numerous species, the more interesting being a handsome new *Euhadra*, a sharply-carinate new *Helicina*, and specimens of *Blanfordia japonica* A. Adams. This last is perfectly distinct from the mainland form I called *B. jap.* var. *simplex*, which will now be raised to specific rank. *B. japonica* has a strong rounded ridge or varix behind the lip, such as is seen in many *Truncatellas*. Mr. Nakada returned to Kyoto, and started, November 5th, for Tosa province, in